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R WATERSHED PROTECTION AND FLOOD PREVENTION

BLACK CREEK-MASON WATERSHED

Mason County, Michigan

OUR SOIL ★ OUR STRENGTH

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volts

WATERSHED WORK PLAN

BLACK CREEK WATERSHED

Mason County, Michigan

Prepared under the authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83rd Congress, 68 Stat. 666) as amended.

Prepared by:

Mason County Soil Conservation District
Black Creek Drainage District

With Assistance By:

U. S. Department of Agriculture, Soil Conservation Service
U. S. Department of Agriculture, Forest Service

June 1963

THE WATERSHED WORK PLAN

Black Creek (Mason) Watershed

Mason County, Michigan
June 1963

SUMMARY OF PLAN

This watershed work plan for the Black Creek Watershed was prepared by the Mason County Soil Conservation District and the Black Creek Drainage District as sponsoring local organizations with assistance provided by the Soil Conservation Service and the Forest Service of the U. S. Department of Agriculture.

The watershed has an area of 10.5 square miles (6,678 acres) and is located in the west central part of the Lower Peninsula of Michigan.

The principal problems in the watershed are of frequent inundation and inadequate drainage outlets. Floods occur during the growing season, at the time of spring breakup, and in the fall.

There are an estimated 87 farms or parts of farms within the watershed. Owners of 49 of these farms are cooperators with the Mason County Soil Conservation District and of these, 30 have basic soil and water conservation farm plans. Average size farm is approximately 100 acres.

Land use in the joint floodwater and inadequate drainage area is distributed among cropland 79.5%; pasture 3.7%; woodlands 12.1%; and idle and miscellaneous 4.7%. This area, shown in Figure 1, includes portions of 21 farms. The cropland benefited from alleviation of floodwater damages and improved adequate drainage is 1,093 acres.

To provide the level of flood protection desired and to provide the needed drainage outlets, this work plan provides for the installation of 6.3 miles of multiple purpose channel improvements (flood prevention and agricultural water management (drainage)). This improvement along with the land treatment measures will provide flood protection such that flooding will not result up to a 10 year frequency storm.

The total project benefits are estimated at $13,152 and include total flood prevention benefits of $6,037 and agricultural water management (drainage) benefits of $7,115.

The land treatment measures to be installed include all appropriate measures having hydrologic significance in reducing flooding frequency or that contribute to achieving the planned agricultural water management benefits. The measures are listed in Table 1.

The land treatment measures to be installed by individual landowners are estimated to cost $49,155. Additional technical assistance to accelerate the planning and application of the land treatment measures will be provided from PL-566 funds at an estimated cost of $8,310. These funds are in addition to the technical assistance costs to be provided by "going" programs estimated at $4,250.

The structural measures included in the work plan are estimated to cost $94,956 of which the PL-566 share is $53,121 and the other than PL-566 share is $41,835. The average annual operation and maintenance costs for the structural measures to be provided by the local sponsoring organizations is $862.

The benefit cost ratio for the project is 2.9 to 1.0.

DESCRIPTION OF THE WATERSHED

PHYSICAL DATA

The Black Creek Watershed is located in Mason County in the west central part of the Lower Peninsula of Michigan. It lies approximately 10 miles from Lake Michigan. The watershed, with a total area of 6,678 acres (10.5 square miles), is approximately 5.5 miles in length. The width varies from 2.5 - 1.5 miles.

Drainage

The Black Creek headwaters rise just north of the Village of Scottville and flow in a general easterly direction, then turn south around the village of Custer to its outlet into the Pere Marquette River. From this point, the Pere Marquette River flows in a westerly direction and outlets into Lake Michigan at the city of Ludington. The major tributaries of Black Creek are the Tuttle Drain, Falconer Drain, "W" Drain, and the Cassie Drain.

Topography

The upper two-thirds of the watershed has a relatively flat floodplain with slightly higher, gently undulating, land toward the designated watershed boundaries. This type of topography is conducive to flood damage and inadequate drainage. In the lower one-third of the watershed the stream is well entrenched with flooding confined to a relatively narrow ravine. The land on either side is rolling and well above the stream bottom.

Soils

The area is comprised of fine and moderately fine textured soils. There are some areas of sandy loam and loamy sands underlain by fine textured material. The majority of the area is composed of imperfectly drained soils with minor areas of well drained and poorly drained soils. Most of the soils are slowly to very slowly permeable. They are productive and in capability classes III and some IV. All of the locally common agricultural crops can be grown if adequately drained.

Climate

There are no U. S. Weather Bureau Stations in the watershed. The nearest temperature and precipitation recording station is located ten miles to the west in Ludington, Michigan. Due to the fact that Ludington is located on the shores of Lake Michigan, its weather is greatly influenced by the Lake. It appears that the station in Hart, Michigan, which is 20 miles to the south and approximately 8 miles inland from Lake Michigan, might more nearly parallel climate conditions of the watershed. The pertinent climatic data from these two stations are as follows:

	HART	LUDINGTON
January Average Temperature	24.2° F	24.7° F
July Average Temperature	70.4° F	69.2° F
Maximum Temperature	104 ° F	97 ° F
Minimum Temperature	-24 ° F	-21 ° F
Last Killing Frost in Spring (ave.)	May 21	May 9
First Killing Frost in Fall (ave.)	September 30	October 23
Length of Growing Season (ave.)	132 days	167 days
Average Annual Precipitation	31.67 inches	29.21 inches

The average annual precipitation during the period of April through October represents approximately 65% of the yearly total with the greatest precipitation occurring in June.

Woodland

There are a total of about 656 acres of woodland and 150 acres in poor aspen and alder or brushy cover more suitably classified as game cover than productive woodland. About 500 acres has potential as woodland capable of producing a timber crop.

Timber types are primarily mixed hardwoods with maple, ash, elm, and other northern hardwood associated trees. Livestock have access to some of the woodlands. If these areas receive protection from grazing, then the growing stock can be carried to maturity and provisions for regeneration and stand improvement will successfully maintain the woodland.

Average volume per acre will be around 3 MBB/acre. A limited amount of cutting has occurred in the past and appears to have been primarily for local use.

Economic Data

The watershed is almost entirely rural. The village of Custer, population 275, is within the watershed boundaries. The village of Scottville, population 1,150, is located in the southwest portion of the watershed with watershed boundaries including a small portion of the village. Total population of watershed is estimated to be 725.

There are an estimated 87 farms or parts of farms within the watershed. Owners of 49 of these farms are cooperators with the Mason County Soil Conservation District and of these, 30 have basic soil and water conservation farm plans. Average size farm is approximately 100 acres.

The principal farming operations in the watershed are dairying and growing cashcrops. Principal crops grown are corn, snap beans, grains, hay and pasture. Approximately half of the corn is grown for silage. Snap bean production is increasing in the area due to favorable climatic conditions and the location of a processing plant at Scottville. These conditions tend to have a leveling effect on the economy of the area.

U. S. Highway 10 crosses the lower part of the watershed in a west to east direction. U. S. Highway 31 crosses the watershed at its western boundaries. There is an irregular system of secondary roads in the watershed. Primarily, these roads are laid out on section lines but many of them are not continuous because of swampy areas or potholes.

The Chesapeake and Ohio Railroad crosses the watershed paralleling the route of U. S. Highway 10.

All of the lands in the watershed are privately owned. The present value of lands in the floodplain areas vary from $50 (potholes) to $175 (cropland).

Present land use in the bottomland area, upland area and for the entire watershed is estimated to be as follows:

PRESENT LAND USE	BOTTOMLAND (acres)	UPLAND (acres)	TOTAL FOR WATERSHED (acres)
Cropland	1,022	4,075	5,097
Pasture	48	240	288
Woods (including brush)	156	650	806
Idle and Misc.	60	427	487
TOTAL	1,286	5,392	6,678

WATERSHED PROBLEMS

Floodwater and Drainage Problems

Flood damage occurs a number of times each year during the growing season and in the fall. The spring breakup also causes flood damage and delayed planting.

The main stem of Black Creek and its major tributaries, through the reaches to be improved, are established county drains. These drains, as originally constructed, have inadequate capacity to handle flooding and provide drainage outlets.

Floods occur a number of times every year usually at the time of spring breakup, in the fall, and also in the growing season. Spring floods do not result in high direct damage to crops and pasture but they do bring about a delay in tillage operations resulting in crop yields that are depressed due to late planting. Flooding in the fall of the year hampers harvest operations resulting in considerable loss in yields. Minor floodwater damages occur to township roads and bridges.

Nearly all the lands shown on Figure I as area to be benefited by flood prevention and drainage, need some type of artificial

drainage improvement for optimum agricultural use. The installation of these improvements is dependent on a substantial reduction of flooding and an improved drainage outlet on Black Creek.

Sediment and Erosion Damage

Erosion and sedimentation problems were considered and investigated during the process of work plan development. The investigations included field observations, interviews with farmers, and interviews with local technicians. On the basis of these studies, it was concluded that erosion and sedimentation damages were not of sufficient magnitude to warrant further detailed investigation.

PROJECTS OF OTHER AGENCIES

There are no known projects of other agencies that would affect or be affected by the works of improvement proposed in this work plan for installation in the Black Creek Watershed.

BASIS FOR PROJECT FORMULATION

The local sponsoring organizations outlined their project objectives prior to the initiation of detailed watershed surveys and investigations. The objectives included the development of an accelerated program of soil and water conservation in the watershed. This phase of the program was recognized as a necessary complement to the structural measures to be planned. It was a principal objective that a 10-year level of flood protection and adequate drainage outlets be provided on the Black Creek Main, Tuttle Drain, Falconer Drain and a new lateral located in Section 9 of the watershed. No interest was shown by the sponsors for improvement on the remaining tributaries.

The selection of structural measures was based on the needs for sufficient depth to provide adequate drainage outlets. The main stem has to be improved to provide the needed depth. It was determined that first consideration should be given to the possibility of floodwater retarding structures and that channel improvements to handle floodwater damage should be considered only as a supplemental measure necessary to the attainment of project objectives.

A study was made of the watershed for possible floodwater retardation sites. It was found that, due to topography, there were no available floodwater retardation sites that would provide any significant flood protection to the damage area. The impracticability of using floodwater retarding structures necessitated the consideration of multiple purpose channel improvements (flood prevention and agricultural water management (drainage)) as a solution to achieve project objectives.

WORKS OF IMPROVEMENT TO BE INSTALLED

Land Treatment Program

In formulating plans for measures to be installed to achieve the desired project objectives, first consideration was given to the development of a land treatment program. Such a program was recognized as a basic and necessary complement to the needed structural measures.

The Mason County Soil Conservation District Board of Directors have made determinations as to the land treatment measures that watershed farmers would install during the period of project installation. These measures are primarily for watershed protection and agricultural water management (drainage).

The establishment of the contemplated land treatment program is essential to the functioning of the structural measures as planned. They are necessary to assure the functioning of the improved channel at operation and maintenance costs consistent with those shown in Table 4. The attainment of the project agricultural water management benefits will be dependent upon the application of the planned land treatment measures of a drainage type.

The land treatment measures proposed for installation are as follows: basic conservation farm plans, 22; district cooperators, 12; basic conservation farm plan revisions, 11; standard soil surveys, 3,000 acres; conservation cropping systems, 2,000 acres; plow planting, 200 acres; stripcropping field, 550 acres; grassed waterways, 10 acres; pasture renovation, 75 acres; pasture planting, 150 acres; cover cropping, 600 acres; crop residue use, 300 acres; wildlife habitat preservation, 200 acres; wildlife wetland preservation, 50 acres; wildlife food plantings, 10 acres; pond area plantings, 6 acres; field windbreaks, 1 acre; farm ponds, 6; tile drains, 55,000 feet; mains and laterals, 10,000 feet; ditch bank seeding, 10,000 feet; surface field ditches, 2,500 feet; drainage structures, 5; grade stabilization structures, 1; livestock exclusion, 25 acres; sustained yield management, 50 acres; timber stand improvement, 50 acres; tree planting (open field), 10 acres.

The land treatment measures will be installed by individual landowners. Some drainage land treatment measures will require the cooperation of small groups of farmers.

A number of tile systems will outlet into lateral (side) ditches off the main to insure a free outlet.

STRUCTURAL MEASURES

Multiple Purpose Channel Improvements

The main stem of Black Creek will be improved beginning near the center of Section 9 of the watershed and extending upstream

3.7 miles. The lengths of tributary improvement, as measured from the confluence with the main, are as follows: Tuttle Drain 1.3 miles, Falconer Drain 0.8 mile, and the new lateral 0.5 mile. This gives a total of 6.3 miles of multiple purpose channel improvement which will provide adequate depth for drainage and contain the 10-year frequency flood within channel banks.

Information on channel size, capacity and other design characteristics can be found in Table 3.

Two channel stabilization structures were included in the plan because of the steep gradient of the channel to be improved. One structure is a 12' by 10' concrete drop box on the end of the corrugated metal pipe arch (span 11'7" and rise 7'7") under Filburn Road (Station 93+08) with a 2.5 foot overfall. This will be a full flow structure with a design capacity of 454 c.f.s. The other will be a standard channel drop structure constructed of reinforced concrete with a 5.0 foot overfall located on the new lateral in Section 9 of the watershed. Data for the weir section is as follows: 5.5 feet deep, 4.0 feet wide, 112 c.f.s. discharge through weir section. These drop structures are needed to reduce the amount of fall in the channel thus reducing the velocity sufficiently to reduce erosion of the improved channel.

The estimated installation cost for the channel improvement on the Black Creek Watershed is $94,956. The estimated average annual operation and maintenance cost is $862.

The installation costs and the sharing of those costs by PL-566 funds and other funds are shown in Table 2.

EXPLANATION OF INSTALLATION COSTS

The project installation costs are summarized in Table 1.

Land Treatment Measures

The installation costs shown in Columns 5 and 6 of Table 1, for individual land treatment measures, represents the estimated total cost to landowners in applying the quantities of the practices shown in Column 3. The costs shown include cost sharing assistance that landowners may receive from the Agricultural Conservation Program.

The technical assistance costs shown for the Soil Conservation Service in Column 6 represent the estimated costs to be borne by that agency in providing needed assistance to landowners in planning for and applying the land treatment program. The technical assistance cost shown for the Soil Conservation Service in Column 5 indicates the extent to which the total technical cost can be provided

by the present staff. Column 4 reflects the extent to which the land treatment program will require additional technical assistance costs from P.L. 566 funds. Likewise, the estimated costs of technical assistance for installing the forestry measures are shown in Columns 5 and 6. This assistance will be financed by the going Cooperative Forest Management Program

STRUCTURAL MEASURES

Multiple Purpose Channel Improvements

The total estimated installation costs for the multiple purpose channel improvements planned for the Black Creek Drain are shown in Column 12 of Table 2. Other columns in this table indicate the break-down of costs among construction, engineering and installation services, land easements and rights-of-way, and administration of contract. The installation of culvert of higher quality and greater performance capabilities at Tuttle, Filburn, and U. S. Highway 31 will be a local cost and included in land, easements and rights-of-way cost of project ($15,450).

The construction costs have been determined by arriving at estimated types and quantities of construction items including clearing, excavation (earth), levelling of spoil, pipe drops to safely lower surface water into the improved channel, grading tributary channels back to a stable grade, grade control structures, seeding of ditch banks, berms and inside slopes of the spoil, and the removal of farm bridges which the local sponsoring organizations wish to abandon. The unit costs used to calculate the total estimated construction costs reflect the multiple judgement of local technicians, watershed planning party personnel, and the State Conservation Engineer as to costs that probably would be involved in awarding a contract for this type of construction in this area.

The land rights costs are based on a $100 per acre cost for the lands necessary for the location of the channel improvements and the necessary work area for spoil spreading. This estimated cost for land was determined by the local sponsoring organizations to be a fair value for lands involved for channel construction.

Cost Allocation

The costs for the channel improvement have been allocated to the flood prevention and agricultural water management (drainage) purposes by use of the first alternate (paragraph 1132.211 of the Watershed Protection Handbook).

Joint cost allocation percentages were estimated to be flood prevention 45.9% and drainage 54.1%. Total costs allocated to each purpose were flood prevention $43,585 and drainage $51,371. Distribution of costs by purpose for flood prevention were PL-566 $31,446 and other $12,139; for drainage they were PL-566 $21,675 and other $29,696.

Basis for Determining Cost Sharing

Cost sharing of costs allocated to agricultural water management was based on the following watershed handbook criteria: Fifty percent of the construction cost and 100 percent of engineering services will be provided by PL-566 funds. The installation cost of the multiple purpose channel as a result of cost allocation and cost sharing was estimated to be PL-566 $53,121 (55.9%); other $41,835 (44.1%).

The installation of the project will be accomplished in a period of five years. An estimated schedule of Federal and non-Federal obligations by fiscal years is as follows:

FISCAL YEARS	PL-566 (Dollars)	Other (Dollars)	Total (Dollars)
First			
Land Treatment	3,000	10,060	13,060
Black Creek Drain (L.E. & R/W (Black Creek Multiple Purpose Channel Improvement))	------	23,600	23,600
Construction Contract	41,502	15,390	56,892
Installation Services	8,715	------	8,715
Administration of Contract	------	2,000	2,000
TOTAL	53,217	51,050	104,267
Second			
Land Treatment	2,000	8,200	10,200
Black Creek Installation Services	2,904	-----	2,904
Administration of Contract	-----	845	845
TOTAL	4,904	9,045	13,949
Third			
Land Treatment	1,104	8,200	9,304
TOTAL	1,104	8,200	9,304
Fourth			
Land Treatment	1,103	7,500	8,603
TOTAL	1,103	7,500	8,603
Fifth			
Land Treatment	1,103	6,885	7,988
TOTAL	1,103	6,885	7,988
GRAND TOTAL	61,431	82,680	144,111

EFFECTS OF WORKS OF IMPROVEMENT

The installation of the proposed multiple purpose channel improvements will substantially reduce the flooding occurrence in the watershed problem area outlined in Figure 1. The installation of the 6.3 miles of channel improvement will change the flooding frequency from annually, and at times several floods in a single year, to an average of once in ten years. The road crossings which are presently subject to flooding will receive benefits due to the proposed works of improvement.

The proposed channel improvements will also provide adequate drainage outlets for the problem area. The two channel grade control structures will stabilize the channel bottom in the areas which presently have excess bottom slope for soil conditions.

The significant reduction in flooding frequency of the problem area along with the opportunity to obtain adequate drainage outlets will result in some land use changes and increased crop yields. The extent of anticipated changes are summarized under "Economic Investigations" in Section 2 of this work plan.

PROJECT BENEFITS

The total annual flood prevention benefits as a result of the project are estimated to be $6,037 (Table 5). These benefits result from a more intensive use of existing cropland and changed land use such as the conversion of woodlands and pasture or idle lands to cropland.

The direct identifiable drainage benefits accruing as a result of the multiple purpose channel improvements are estimated to be $7,115 annually. These benefits result primarily from an increase in yields due to improved drainage on existing cropland and from changes in land use from woodland, pasture or idle lands to cropland.

The land treatment measures proposed in Table 1, page 16, will not only reduce erosion damage but also reduce downstream sedimentation and channel maintenance.

Comparison of Benefits and Costs

The ratio of the estimated average annual benefits to costs for the multiple purpose channel improvement is 2.9 to 1. Only primary benefits have been used in the benefit cost analysis. Table 5 presents a comparison of benefits and costs for the structural works of improvement.

[illegible] OF THE PROBLEM

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[illegible] area outlined in Figure [illegible] The investigation of
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[illegible] flooding [illegible] areas [illegible] recent years.
[illegible] of [illegible] to [illegible] projects which are
[illegible] economically justifiable [illegible] benefits due to the
[illegible] improvement.

[illegible] channel improvements [illegible] adequate
[illegible] for the problem area. [illegible] channel, [illegible] conditions
[illegible] alleviate the damage [illegible] in the area which
[illegible] have arisen because [illegible] flood conditions.

[illegible] introduction in flood [illegible] of the previous
[illegible] the opportunity to obtain [illegible] drainage [illegible]
[illegible] the land use changes and [illegible] [illegible] The
[illegible] flood damages are summarized [illegible] economic feasibility
[illegible] in this work plan.

PROJECT SELECTION

[illegible] found to be preventing [illegible]
[illegible] called for in S.R. 345 (Pub. [illegible]
[illegible] given [illegible] [illegible] [illegible] [illegible]
[illegible] overcome [illegible] conditions and [illegible] [illegible] lands [illegible]

[illegible] considerable damage [illegible]
[illegible] channel improvement [illegible]
[illegible] benefits [illegible]
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[illegible] floodland. [illegible] in floodland.

[illegible] feasible projects [illegible]
[illegible] damage but also [illegible] [illegible]
[illegible] resources.

[illegible] OF PROJECT [illegible]

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[illegible] channel improvement [illegible] [illegible] only [illegible]
[illegible] in the period [illegible] [illegible]
[illegible] benefits and [illegible] [illegible]

PROJECT INSTALLATION

Land Treatment Measures

The local landowners will carry out the land treatment program in cooperation with the Mason County Soil Conservation District within the watershed during the five year installation period and will encourage landowners and operators to maintain the land treatment measures for protection and improvement of the watershed.

The Soil Conservation Service will furnish sufficient technical assistance to the Mason County Soil Conservation District to carry out the accelerated program of land treatment. SCS technicians will assist landowners and cooperators of the Mason County Soil Conservation District in the preparation of soil and water conservation farm plans and in the application of soil and water conservation practices. The Public Law 566 funds needed for the acceleration of the land treatment program as shown in Table 1 were determined by calculating the extent to which added technical assistance would be needed from PL-566 funds.

Technical assistance for installing the forestry measures will be provided the landowners by the Michigan Department of Conservation, in cooperation with the U. S. Forest Service, under the going Cooperative Forest Management Program.

The Agricultural Conservation Program Service will assist farmers with the installation of the land treatment practices through the cost sharing provisions of that program.

Structural Measures

The Soil Conservation Service will disburse Federal funds and furnish technicians to complete field surveys necessary for final design plan purposes of works of improvement, preparation of specifications for bids, supervision of construction, and certification of payments.

The Black Creek Drainage District has the authority to levy assessments to raise local funds for cost sharing for construction of the structural measures, for administration of contracts, and for furnishing land rights (including the power of eminent domain) for the installation of the multiple purpose channel improvements. The Black Creek Drainage District will exercise this authority. The District can provide the lump sum amounts of money needed for construction purposes by issuance of negotiable drainage orders to be repaid from drainage assessments collectable in future years.

FINANCING PROJECT INSTALLATION

Land Treatment Measures

The land treatment measures will be installed by the landowners or farm operators under a program of voluntary cooperation with the Mason County Soil Conservation District.

[illegible]

[illegible] Measures

[illegible] and improvement of treat[illegible] conservation [illegible] maintain the land treatment [illegible] of the watershed.

The Soil Conservation Service will furnish sufficient technical [illegible] only [illegible] installation first [illegible] treatment. SCS technicians [illegible] and [illegible] cooperation [illegible] County Soil Conservation District in the [illegible] water [illegible] farm plans and in the application of soil [illegible] conservation practices. The [illegible] needed for [illegible] of the land treatment program was [illegible] by calculating the extent [illegible].

Technical assistance [illegible] forestry measures will be provided [illegible] Conservation [illegible] Corp[illegible].

The Agricultural [illegible] will assist farmers [illegible] through the [illegible].

Structural Measures

The [illegible] and furnish [illegible] necessary [illegible] design [illegible] of [illegible].

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Land Treatment Measures

The land [illegible] installed by the [illegible] of farm cooperators [illegible] maintenance [illegible] County Soil [illegible].

The estimated cost for establishment of the land treatment measures during the five year project installation period is $49,155 as shown in Table 1. This includes technical assistance costs to be borne by the Soil Conservation Service, going Cooperative Forest Management Program, and an expected reimbursement from the Agricultural Conservation Program.

The Soil Conservation Service will provide the Mason County Soil Conservation District with the technical assistance necessary for the installation of the land treatment program outlined in Table 1. This will require an estimated additional $8,310 in technical assistance costs during the five year installation period over and above the assistance that can be provided by the present staff of the Work Unit serving the district. As shown in Table 1, it is expected that the staff presently available in the Work Unit will provide during the project installation period technical assistance costing about $3,840. Cost sharing assistance for the installation of many of the measures may be available from the Agricultural Conservation Program Service.

The Michigan Department of Conservation, Forestry Division, in cooperation with the U. S. Forest Service will provide the technical assistance needed by woodland owners in carrying out and maintaining the planned land treatment measures on forest lands. The total technical assistance costs for the forestry phase of the land treatment program will be financed as follows: $410 in funds to be made available by the State Forestry "going program" to provide the needed accelerated forestry program.

Structural Measures

The Black Creek Drainage District is a district legally organized under the Drainage Laws of the State of Michigan.

The Black Creek Drainage District plans to finance the local share of installation costs for improvements on the Black Creek Drain through a loan from the Farmers Home Administration. They have had some preliminary discussions on the matter with a representative of the Farmers Home Administration and expect to file a letter of intention at an early date.

Land, easements and rights-of-way will be obtained for a channel improvement before PL-566 funds are available for its construction. There is no indication at this time as to the extent to which the needed land rights will be obtained through donation. This will be determined only at the time of negotiating with the affected property owners for the necessary land rights.

It is understood that all financial and other assistance to be provided by the Soil Conservation Service and by PL-566 funds is contingent upon appropriation of funds for watershed program purposes.

PROVISIONS FOR OPERATION AND MAINTENANCE

Land Treatment Measures

The land treatment measures will be installed, operated and maintained by the landowners or operators. This will be accomplished under district cooperator agreements with the Mason County Soil Conservation District. Assistance to landowners for the maintenance of the forest land treatment measures will be provided by the Michigan Department of Conservation, Forestry Division, in cooperation with the U. S. Forest Service through the Cooperative Forest Management Program.

Structural Measures

The multiple purpose channel improvements and grade stabilization measures will be operated and maintained by the Black Creek Drainage District. The average annual cost for this operation and maintenance has been estimated to be $862. The Black Creek Drainage District will maintain and finance the maintenance of the channel improvement in the manner provided by the Michigan Drainage District Laws.

The following items will be provided for in the maintenance program:

1. A periodic inspection will be made of the structural works of improvement as needs arise but at least annually. The inspection will be made by a representative of the Drainage District.

2. A representative of the Soil Conservation Service will make inspections with the local organization, if possible, although separate inspections may be made.

3. All costs for labor, equipment, and materials for operation and maintenance, will be furnished by the appropriate local sponsoring organization.

4. Maintenance rights-of-way will be furnished to the structural measure by the Black Creek Drainage District.

5. A record will be maintained of all inspections, with one copy kept by the sponsoring local organization and another copy by the Soil Conservation Service.

6. Special inspections will follow severe or intense storms or incidents that may occur.

7. A specific maintenance agreement between the Soil Conservation Service and the Black Creek Drainage District will be executed prior to the issuance of invitations to bid on construction contracts.

[illegible] OPERATION AND MAINTENANCE

[illegible] Management

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

The structural measures for grade stabilization will require timely maintenance to assure they function properly. All debris and undesirable vegetal growth at, or adjacent to, the stabilizing structures will be removed promptly. Scour damage due to local runoff or to high frequency storms will be repaired and stabilized by desirable vegetal growth.

The continued functioning of the multiple purpose channel improvements in providing the degree of flood protection for which it was designed and in serving as an adequate drainage outlet will require a timely maintenance program. This will require the control of undesirable vegetal growth by mowing and/or spraying, resloping of eroding banks, and the removal of debris and sediment bars. The proper location and installation of each drainage appurtenance will do much toward the maintenance of the improved channels.

It is expected that channel "cleanouts" will be needed every 10-15 years to keep the channel in proper operating condition. At such times, seedings will be renewed as necessary on the channel banks, berms, and inside slopes of the spoil.

TABLE 1 - ESTIMATED PROJECT INSTALLATION COST
Black Creek (Mason) Watershed, Michigan

Installation Cost Item	Unit	No. Non Fed. Land	Estimated Cost (Dollars) 1/		
			PL-566 Funds Non Fed Land	Other-Non Fed. Land	Total
(1)	(2)	(3)	(4)	(5)	(6)
Land Treatment					
Soil Conservation Service					
Basic Farm Conservation Plans	No.	22			
District Cooperators	No.	12			
Basic Farm Conservation Plans (Revised)	No.	11			
Standard Soil Surveys	Acres	3,000			
Conservation Cropping Systems	Acres	2,000			
Plow Planting	Acres	200			
Stripcropping, Field	Acres	550		2,200	2,200
Grassed Waterways	Acres	10		1,720	1,720
Pasture Renovation	Acres	75		1,875	1,875
Pasture Plantings	Acres	150		4,500	4,500
Cover Cropping	Acres	600		3,000	3,000
Crop Residue Use	Acres	300			
Wildlife Habitat Preservation	Acres	200			
Wildlife Wetland Preservation	Acres	50			
Wildlife Food Plantings	Acres	10		250	250
Pond Area Plantings	Acres	6		150	150
Field Windbreaks	Acres	1		25	25
Farm Ponds	No.	6		2,400	2,400
Tile Drains	Feet	55,000		13,750	13,750
Mains and Laterals	Feet	10,000		3,300	3,300
Ditch Bank Seeding	Feet	10,000		500	500
Surface Field Ditches	Feet	2,500		125	125
Drainage Structures	No.	5		1,250	1,250
Grade Stabilization Structure	No.	1		400	400
Technical Assistance			8,310	3,840	12,150
SCS Subtotal			8,310	39,285	47,595
Forest Service					
Livestock Exclusion	Acres	25		100	100
Sustained Yield Management	Acres	50		50	50
Timber Stand Improvement	Acres	50		600	600
Tree Planting (Open Field)	Acres	10		400	400
Technical Assistance				410	410
FS Subtotal				1,560	1,560
TOTAL LAND TREATMENT			8,310	40,845	49,155

TABLE 1 - ESTIMATED PROJECT INSTALLATION COST - Continued

Installation Cost Item	Unit	No. Non Fed.Land	Estimated Cost (Dollars) 1/		
			PL-566 Funds Non Fed Land	Other-Non Fed.Land	Total
(1)	(2)	(3)	(4)	(5)	(6)
Structural Measures					
Soil Conservation Service					
Multiple Purpose Channel Improvement (Flood Prevention & Ag. Water Mgt. (drainage))	Miles	6.3	41,502	15,390	56,892
Subtotal Construction		6.3	41,502	15,390	56,892
Installation Services					
Soil Conservation Service					
Engineering Services			8,534		8,534
Other			3,085		3,085
Subtotal Installation Services			11,619		11,619
Other Costs					
Land, Easements & R/W				23,600	23,600
Administration of Contracts				2,845	2,845
Subtotal Other				26,445	26,445
TOTAL STRUCTURAL MEASURES			53,121	41,835	94,956
TOTAL PROJECT			61,431	82,680	144,111
SUMMARY					
Subtotal SCS			61,431	81,120	142,551
Subtotal FS				1,560	1,560
TOTAL PROJECT			61,431	82,680	144,111

Date June 1963

1/ Price Base 1962

[illegible]

TABLE 1A - STATUS OF WATERSHED WORKS OF IMPROVEMENT
Black Creek (Mason) Watershed, Michigan

(at time of work plan preparation)

MEASURES (1)	UNIT (2)	APPLIED TO DATE (3)	TOTAL COST (Dollars) 1/ (4)
Land Treatment			
Basic Farm Conservation Plans	No.	30	------
District Cooperators	No.	49	------
Standard Soil Surveys	Acres	3,700	------
Conservation Cropping Systems	Acres	1,091	------
Stripcropping, Field	Acres	155	620
Grassed Waterways	Acres	4	688
Pasture Plantings	Acres	70	2,100
Pasture Renovation	Acres	47	1,175
Cover Cropping	Acres	195	975
Crop Residue Use	Acres	107	------
Wildlife Habitat Preservation	Acres	33	------
Tree Planting	Acres	7	280
Surface Field Ditches	Feet	3,150	158
Tile Drains	Feet	34,943	8,736
Mains and Laterals	Feet	8,940	2,950
Tile System Structure	No.	1	300
TOTAL	xxxxx	xxxxxx	17,982

Date June 1963

1/ Price Base 1962

TABLE 2 - ESTIMATED STRUCTURAL COST DISTRIBUTION

Black Creek (Mason) Watershed, Michigan

(Dollars) 1/

Structure	Installation Cost-PL 566 Funds				Installation Cost - Other Funds						
		Install.Serv.					Other				
	Construction	Engineering	Other	Total PL-566	Construction	Inst. Serv.	Adm. of Cont.	Easements & R/W	Water Rights	Total Other	Total Inst. Cost
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Multiple Purpose Channel Improvement Black Creek Drain	41,502	8,534	3,085	53,121	15,390	---	2,845	23,600	---	41,835	94,956
GRAND TOTAL	41,502	8,534	3,085	53,121	15,390	---	2,845	23,600	---	41,835	94,956

Date June 1963

1/ Price Base 1962

TABLE 3 - STRUCTURE DATA

CHANNELS

Black Creek (Mason) Watershed, Michigan

Channel Designation (Total Lineal Miles)	Sta.	Sta.	Distance Lineal Miles	Average Side Slope Ratio	Average Bottom Width	Average Channel Depth	Average Bottom Slope	Excavation Volume
					(ft.)	(ft.)	(ft./ft.)	(Cu. Yds.)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Black Creek (3.70)	68	119	0.97	2:1	4.0	5.0	.0005	10,250
	119	173	1.02	2:1	4.0	5.0	.0005	11,022
	173	193	0.38	2:1	6.0	5.6	.0020	427
	193	205	0.23	2:1	6.0	6.0	.0020	679
	205	236	0.59	2:1	8.0	6.0	.0020	7,978
	236	250	0.26	2:1	8.0	6.0	.0020	5,211
	250	263	0.25	2:1	8.0	6.0	.0020	1,431
Falconer Drain (0.85)	504	515	0.21	2:1	4.0	5.0	.0040	1,153
	515	530	0.28	2:1	4.0	5.0	.0005	4,919
	530	549	0.36	2:1	4.0	5.0	.0025	6,337
Tuttle Drain (1.27)	310	363	1.00	2:1	4.0	5.0	.0005	3,386
	363	377	0.27	2:1	4.0	5.0	.0040	5,040
New Lateral (0.53)	410	438	0.53	2:1	4.0	5.0	.0040	10,390

TABLE 3 - STRUCTURE DATA Cont'd.

CHANNELS

Black Creek (Mason) Watershed, Michigan

Channel Designation (Total Lineal Miles)	Sta.	Sta.	Watershed Area	Hydraulic Radius	Value of "n"	Hydraulic Grade Slope	Channel Velocity	Channel Area	Estimated Channel Capacity	Required Capacity
			(sq. mi.)	(ft.)		(ft./ft.)	(ft./sec.)	(sq.ft.)	c.f.s.	c.f.s.
(1)	(2)	(3)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
Black Creek (3.70)	68	119	0.40	2.66	.035	.0005	1.83	70.0	128	43
	119	173	0.84	2.66	.035	.0005	1.83	70.0	128	94
	173	193	3.89	3.10	.035	.0020	4.03	96.3	388	385
	193	205	4.93	3.29	.035	.0020	4.20	108.0	454	455
	205	236	5.38	3.45	.035	.0020	4.33	120.0	520	482
	236	250	6.02	3.45	.035	.0020	4.33	120.0	520	540
	250	263	6.26	3.45	.035	.0020	4.33	120.0	520	540
1/ Falconer Drain (0.85)	504	515	0.13	0.98	.040	.0040	2.30	10.5	24	23
	515	530	0.28	1.72	.040	.0005	1.19	30.0	36	35
	530	549	0.42	1.43	.040	.0025	2.32	21.1	48	45
1/ Tuttle Drain (1.27)	310	363	0.50	2.19	.040	.0005	1.40	48.0	66	60
	363	377	0.99	1.82	.040	.0040	3.51	33.3	117	115
1/ New Lateral (0.53)	410	438	0.49	1.72	.040	.0040	2.98	21.1	63	60

1/ Values shown for these drains represent approximate Q_{10} flow, less than bank full.

TABLE 4 - ANNUAL COST

Black Creek (Mason) Watershed, Michigan

(Dollars) 1/

Evaluation Unit (1)	Amortization of Installation Cost 2/ (2)	Operation and Maintenance Cost (3)	Other Economic Cost (4)	Total (5)
Black Creek Drain	3,691	862		4,553
TOTAL	3,691	862		4,553

Date June 1963

1/ Price Base 1962 for installation costs.
1961 - projected long term for benefits, operation & maintenance, and other economic costs.

2/ 3% - 50 year amortization period.

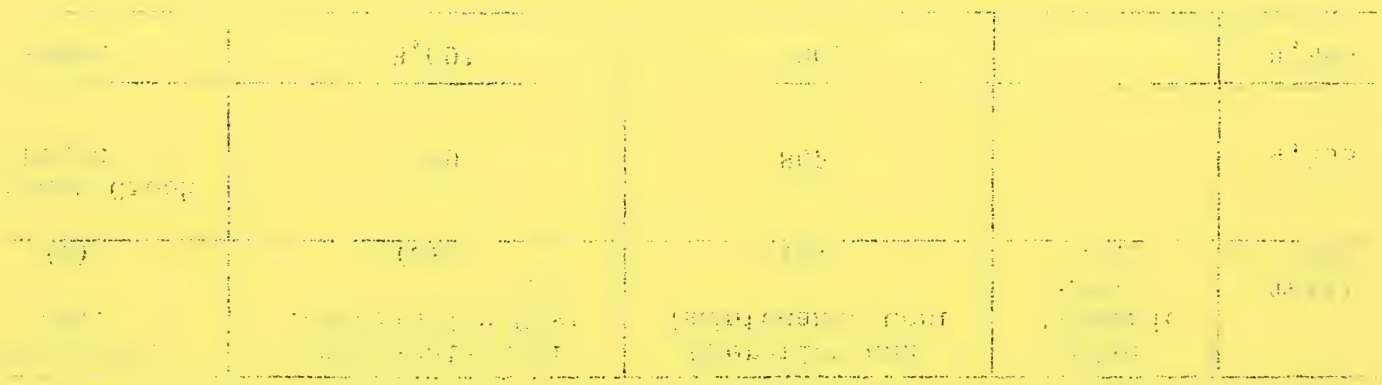


TABLE 5 - COMPARISON OF BENEFITS AND COSTS FOR STRUCTURAL MEASURES

Black Creek (Mason) Watershed, Michigan

(Dollars) 1/

Evaluation Unit	AVERAGE ANNUAL BENEFITS			Average Annual Cost	Benefit Cost Ratio
	Flood Prevention	Agr. Water Mgt.			
	More Intensive Land Use and Changed Land Use	Drainage	Total		
(1)	(2)	(3)	(4)	(5)	(6)
Black Creek Drain	6,037	7,115	13,152	4,553	2.9:1.0
GRAND TOTAL	6,037	7,115	13,152	4,553	2.9:1.0

Date June 1963

1/ Price Base 1962 - Installation Cost
1961 projected long term for benefits, operation and maintenance and other economic costs.

INVESTIGATIONS AND ANALYSIS

Hydrologic and Hydraulic Studies

There are no rainfall or stream gaging stations located within the Black Creek Watershed. The rainfall amounts were determined from U. S. Weather Bureau Technical Paper # 40.

A total of ten valley cross sections were taken in the floodplain. Seven on Black Creek and one each on Tuttle, Falconer, and New Drains which are tributaries of Black Creek. These were taken to establish the relationship between discharge (stage) and area flooded for the 50 year, 25 year, 10 year, 5 year, 2 year and 1.1 year frequencies. At each valley section a field survey was made to determine the cross-sectional area within banks and for overbank conditions. A field survey was made to develop the channel profile for Black Creek and the tributaries to be improved. This included 3.7 miles on Black Creek, 1.3 miles on Tuttle Drain, 0.8 mile on Falconer Drain, and 0.5 mile on the new lateral. All survey information was referred to the U.S.G.S. mean sea level datum. Roughness coefficients "n" were determined from field observations for within bank and overbank conditions. Rating curves, which established the relationship between discharge and stage, were based upon information developed using Manning's Formula. Stage-frequency data developed in the hydrologic analyses were used to delineate the areas of floodwater damage.

Discharge amounts for the selected frequencies were determined by flood routing in several damage reaches. In this analysis the discharges were based on converting rainfall to runoff. The rainfall amounts for selected frequencies were obtained from the U. S. Weather Bureau Technical Paper # 40. The without project and with project hydrologic soil-cover complex numbers for the watershed are 82 and 83, respectively. These factors were used to convert rainfall to runoff.

Hydrographs (using a six-hour storm duration) were developed for the sub-areas in the watershed for three runoff amounts. The sub-area hydrographs were combined and flood routed using the Wilson Graphical Method to obtain discharges at the necessary locations within the watershed. The routing was carried downstream beyond the reaches to be improved. This showed Black Creek to have an adequate outlet.

Design discharges for the improved channel will be usable in the operations design. The design discharges were determined by flood routing the 10-year frequency design flood through the watershed by the Wilson Graphical Method.

Studies were made of the available U.S.G.S. stream flow records in the area to determine the relation of the "all year" to the "growing season" occurrence of floods. This study indicated that a discharge-frequency line, based upon "growing season" events only, was lower than the discharges for the same frequencies based upon largest annual events. Factors were developed for the selected frequencies and the discharges and acres flooded at each valley section were modified to reflect the "growing season" occurrence of floods.

Design Investigations

A baseline survey was made of Black Creek and the proposed new lateral located in section 9 of the watershed. Cross sections were taken approximately 10 per mile to determine excavation quantities. A chain survey was made on the Tuttle and Falconer Drains which enter the Black Creek in section 8 of the watershed. Cross sections on the Tuttle and Falconer Drains were taken approximately five per mile to determine excavation quantities. Sixteen soil borings were taken along the 6.3 miles of channel to be improved and used to determine allowable velocity and side slopes. Through field inspection, it was determined that there were no adequate floodwater retarding sites so any flood reduction would be accomplished by channel improvement.

Channel improvement will commence on Black Creek near the center of section 9 (sta. 263+00) and extend 3.7 miles upstream (sta. 68+00). The side drains to be improved are as follows: Tuttle Drain 1.3 miles, Falconer Drain 0.8 mile, and the new lateral 0.5 mile.

Flood control design for Black Creek was based on peak discharges and runoff to be expected during the growing season on the average of once in ten years.

Channel capacity was determined using Mannings' formula. Recommended values for "n", velocity, and side slopes as given in the National Engineering Handbook, Section 16 were used in design.

A study was made on the lower reach of Black Creek which will not be improved to determine if it will provide an adequate outlet. This reach, from the Black Creek confluence with the Pere Marquette River upstream to station 263+00, is approximately 3.0 miles in length. The stream is well entrenched with an average bottom slope of .003 foot per foot. It was determined that the present channel has sufficient capacity to carry the increased discharges without damage through this reach.

County road bridges and culverts affected by the project were investigated to determine capability to carry design flow. The culvert at Tuttle Road (station 230+79) was found to be small and will be replaced with a larger CMP arch. The bridge at Filburn Road (station 193+08) is in a poor state of repair and could not be feasibly underpinned; therefore, it will be replaced with a CMP arch with a drop box for grade control. At station 90+00 a new larger CMP under U. S. Highway 31 will be installed. All other bridges and culverts affected will carry the design flow without alteration.

Aerial photographs, field inspection, and engineering surveys were used to determine units of clearing and side drainage structures. Typical channel cross sections with placement of spoil were used to determine channel right-of-way and seeding acreage.

Economic Investigations

In determining the benefits of the proposed project, an inventory was made of the land use of all the lands in the problem area. The future land use of the watershed was determined to be as follows:

PRESENT LAND USE	BOTTOMLAND (acres)	UPLAND (acres)	TOTAL FOR WATERSHED (acres)
Cropland	1,022	4,075	5,097
Pasture	48	240	288
Woods (including brush)	156	650	806
Idle and Misc.	60	427	487
TOTAL	1,286	5,392	6,678

FUTURE LAND USE	BOTTOMLAND (acres)	UPLAND (acres)	TOTAL FOR WATERSHED (acres)
Cropland	1,093	4,075	5,168
Pasture	24	240	264
Woods (including brush)	109	650	759
Idle and Misc.	60	427	487
TOTAL	1,286	5,392	6,678

Schedules were obtained from interviews by random sampling with the owners and operators of approximately 80% of the lands in the area of floodwater damage and impaired drainage. These schedules indicated the individual farmers (1) present yield, (2) present normal cropping pattern, and (3) anticipated future land use and yields if adequate drainage outlets were provided and a ten year level of flood protection assured.

Information on crop production practices and cost of production and operations was also obtained. This information, in addition to the data on cropping patterns and yields, was evaluated for accuracy and reasonableness by agricultural agency personnel working in the area.

The without project use of cropland and yields in the problem area is as follows:

CROP	PERCENT OF CROPLAND USE	YIELDS PER ACRE
Corn - Grain	20.4	52 Bu.
Corn - Silage	13.6	10 Tons
Snap Beans (Processing)	9.6	1.5 Tons
Wheat	8.5	33 Bu.
Oats	8.5	45 Bu.
Cl.-Mix. Hay	11.0	1.7 Tons
Alf.-Hay	28.4	1.9 Tons

Project benefits were based on increases in average yields expected "with" as compared to "without" project, including consideration due to the present and future flooding. The resulting joint benefits were then allocated to each purpose in the same proportion as costs were to purpose. In this manner it was determined that 54.1% of the channel and appurtenance costs and benefits should be allocated to drainage and 45.9% to flood prevention.

More intensive land use benefits were computed on present cropland acres only. They were based on future net income with flood protection at the ten year level less associated costs as compared to present net income. In this manner more intensive land use benefits of $5,295 (flood prevention) and $6,241 (agricultural water management (drainage)) were determined from 1,022 acres of cropland and pasture. Total benefits of $11,536.

From farm interviews checked with professional agricultural agency personnel working in the area and with the Mason County Soil Conservation District Directors, it was determined that farmers in the problem area would plan for a changed land use of 24 acres of pasture and 47 acres of woods to cropland. Benefits accruing as a result of the conversion of these acres to cropland were determined by (1) estimating the expected future distribution of crops on this acreage, (2) calculating the expected future net income on this acreage, and (3) deducting all associated costs. Benefits of this type were estimated at $1,616 of which $742 is a flood prevention benefit and $874 is an agricultural water management (drainage) benefit.

Future floodwater damages in the floodplain "with project" as a result of increased yields, cropping pattern and land use adjustments were estimated to be $248 annually. Dollar damage values per acre determined in similar watersheds were used, together with an estimate of the total acres flooded by a 50 year frequency storm "with project".

The calculation of annual costs and benefits are based on the assumption that 100% of the needed tributary outlet improvements and 30% of the needed on-farm drainage program will be completed during project installation, an additional 25% of the on-farm drainage will be completed in the first five year period following project installation and 20% will be installed in the period 5-15 years following project installation.

The "with project" land use pattern was estimated as follows:

LAND USE	ACRES	PERCENT
Cropland	1,093	85.0
Pasture	24	1.9
Woods (incl. Brush)	109	8.4
Idle & Miscellaneous	60	4.7
TOTAL	1,286	100.0

The "with project" use of cropland and anticipated yields per acre with adequate drainage were determined to be as follows:

CROP	PERCENT OF CROPLAND USE	AVERAGE YIELDS PER ACRE
Corn - Grain	20.3	73 Bu.
Corn - Silage	13.5	14.5 Tons
Snap Beans (Processing)	9.6	3.0 Tons
Wheat	8.5	46 Bu.
Oats	8.5	75 Bu.
Cl.-Mix. Hay	11.2	3.1 Tons
Alf.-Hay	28.4	3.6 Tons

Economic studies were made in order to determine the economic feasibility of each separate tributary (the main channel, Tuttle Drain, Falconer Drain, and New Drain). Results show all increments to be economically justifiable with benefit cost ratios ranging from 1.2:1.0 to 4.4:1.0.

Cost Allocation

The following costs for channel improvement have been allocated to flood prevention and agricultural water management (drainage) purposes by the method as outlined under Section 1, Cost Allocation, page 9.

The use of this formula resulted in the following cost allocations for the multiple purpose channel:

$$\frac{\$83,472}{\$83,472 + \$70,890} \times \$94,956 = \$51,371 \quad \text{Drainage } 54.1\%$$

$$\$94,956 - \$51,371 = \$43,585 \quad \text{Flood Prevention } 45.9\%$$

Unit prices used in all benefit determinations in this work plan were obtained locally by interview with elevator operators, contractors, farmers, and agricultural agency personnel. Throughout this report 1961 prices were used as a base projected to long term prices for evaluating benefits. In calculating the cost of construction, the estimated prices were based on 1962 costs for materials in place. Operation and maintenance costs were converted to projected long term prices.

For converting public and private investments to annual bases and in amortizing and discounting costs and benefits the following interest rates were used:

A. 3% for converting all installation costs to average annual costs over a 50-year period.

B. 6% for converting local associated on-farm costs to an annual basis.

C. 5% for converting local associated costs on public tributary drains to an annual basis.

D. 3% for discounting of agricultural water management benefits to reflect the anticipated lag in accrual of such benefits.

U.S. DEPARTMENT OF AGRICULTURE

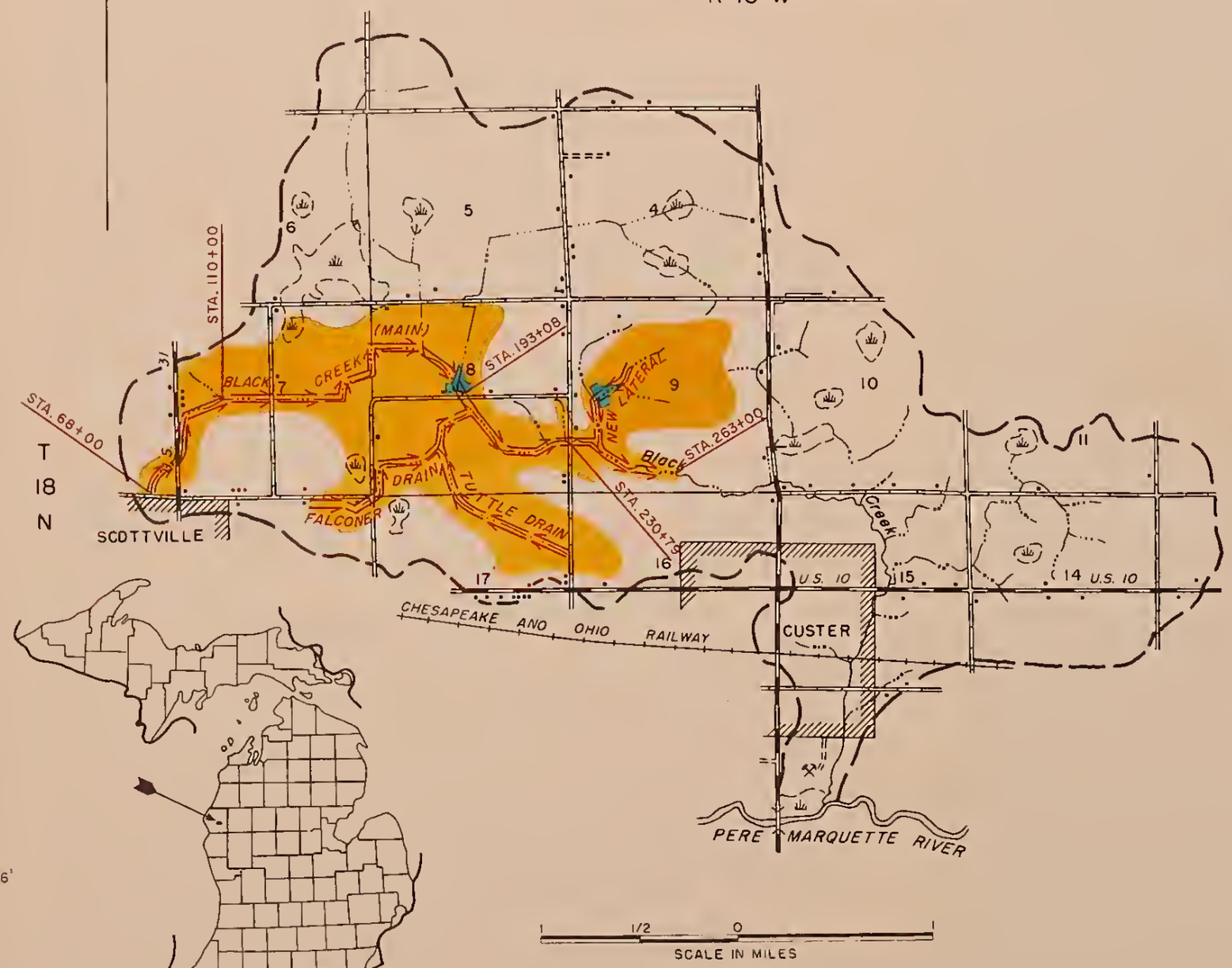
SOIL CONSERVATION SERVICE

PROJECT MAP

BLACK CREEK - MASON WATERSHED

MASON COUNTY, MICHIGAN

R 16 W



LOCATION IN MICHIGAN

LEGEND

- SECTION LINE
- SECTION NUMBER — 22
- PAVED ROAD
- GRAVEL ROAD
- DIRT ROAD
- FARM ROAD
- RAILROAD
- CROSSING (GRADE)
- BRIDGE, ROAD
- HOUSE
- SCHOOL — 1
- CITY
- PERENNIAL STREAM, LARGE
- PERENNIAL STREAM, SMALL
- INTERMITTENT STREAM
- SWAMP
- GRAVEL PIT, QUARRY OR MINE
- WATERSHED BOUNDARY
- MULTIPLE PURPOSE CHANNEL IMPROVEMENT (F.P. & AG. WATER MGT.)
- AREA BENEFITED BY FLOOD PREVENTION & DRAINAGE
- GRADE STABILIZATION STRUCTURE

Figure 1

6-7-63

USDA SCS MILWAUKEE WIS 1963